

REMARKS

By the present amendment, claims 1, 2, 7 and 8 are under consideration in the application. Claims 4 to 6 have been withdrawn from consideration due to the restriction requirement.

Support For Claim Amendments

Claim 1

Support for --free from bald spots-- may be found in the specification, e.g., at page 2, lines 21-24; page 3, lines 13-19; page 8, lines 19-22; page 12, lines 28-31; and Table 3, at page 15. In Table 3, under the column heading "Bald spots", all examples in accordance with the present invention contain the legend "none".

The claim limitations directed to --average surface roughness Ra-- and --pittings-- may be found in original, now canceled, dependent claim 3.

Claim 2

Support for the claim amendments to claim 2 is the same as claim 1.

Support for --one or more-- as defining Cu, Ni, Mo, B and Ca-- may be found in the phrase "alone or in combination" in original claim 2. The specification at page 6, line 17 to page 7, line 4 discloses that Cu, Ni, Mo, B and Ca are optional.

Claim 7

New dependent claim 7 is a dependent product-by-process type claim based upon original dependent method claim 5. The upper limit of --98°C-- may be found in original dependent method claim 4.

Claim 8

New dependent claim 8 is a dependent product-by-process type claim based upon original dependent method claim 6.

Restriction Requirement

Dependent method claims 4 to 6, which have been withdrawn from consideration, contain all the limitations of independent claim 1 (or independent claim 2).

Therefore, if independent claim 1 and/or independent claim 2 is found allowable, it is respectfully requested that the restriction requirement with respect to dependent claims 4 to 6 be withdrawn.

§103

Claims 1 to 3 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Pub. No. 2003/0111144 to Matsuoka et al.

This rejection, as applied to the amended and new claims, is respectfully traversed.

The Present Invention

A characteristic feature of the present invention is to provide a hot rolled steel sheet excellent in chemical convertibility free from bald spots based on the following discoveries.

- 1) Si concentration of less than 3.5% and Mn concentration of less than 3.5% in the surface oxides,
- 2) Surface roughness Ra of 3.0 μm or less,
- 3) Number of pittings of a diameter of 1 μm to 0.3 μm due to the pickling is an average 5 or less in squares of the steel sheet surface when dividing it into squares of 10 μm per side.

For these purposes, the production features are:

- 4) HCl concentration of 7 to 15%,
- 5) Fe ion concentration of 4 to 12%,

6) Immersing a hot rolled steel sheet in a solution temperature of 80 to 98°C for a time in the range of 40 sec or more, and

7) The HCl concentration (mass %) x dipping time (sec) becomes 520 or less.

These features are for the purpose of avoiding generation of bald spots caused by the increase of pitting during over pickling and for avoiding generation of bald spots caused by remaining highly concentrated oxides without non-treated pickling.

Patentability

US 20003/0111144 (“US ‘144”)

The technology disclosed in US ‘144 relates to a hot and cold rolled steel plate and hot dip galvanized steel plate excellent in press-formability and strain aging hardening characteristics as typically represented by a ΔTS of 80 MPa or more. The steel plate of US ‘144 contains $C \leq 0.15$, $Si \leq 2.0\%$, $Mn \leq 3.0\%$, $S \leq 0.02\%$, $N \leq 0.02\%$, $P \leq 0.1\%$, $Al \leq 0.1\%$, $Cu: 0.5 - 3.0\%$, the balance Fe and unavoidable impurities, which comprising a structure having ferrite phase as a main phase forming a composite structure with a secondary phase containing martensite phase in an area ratio of 2% or more.

US ‘144 discloses that the hot rolled steel plate is subjected to galvanizing, Sn plating, and enameling after hot rolling. However, US ‘144 does not disclose or suggest anything specific about chemical conversion treatment of the hot rolled steel plate. US ‘144 discloses that a surface treatment may be applied to the hot rolled steel plate after annealing or galvanizing for improving chemical convertibility. (Page 9, [0151] - [0152]).

However, US ‘144 does not disclose or suggest anything about what type of chemical conversion treatment is applied or how to apply this chemical conversion treatment. It is submitted that this treatment of US ‘144 does not belong to the type of acid pickling of

the hot rolled steel plate because US '144 discloses that this treatment must be carried out after annealing or galvanizing.

Further, US '144 discloses at page 18 [0313], "On the surface of the steel sheet preheated on the continuous annealing line, P in steel is concentrated, and oxides of Si, Mn and Cr are concentrated, forming a surface concentration layer. It is favorable for improving platability to remove this surface concentration layer through pickling and to conduct annealing in a reducing atmosphere subsequently on the continuous hot-dip galvanizing line." This statement does not mean pickling of the hot rolled steel sheet according to the present invention.

US '144 further discloses that temper rolling of 10% or less may be applied to a 2 mm thickness of hot-rolled steel sheet for adjustments such as shape correction and surface roughness adjustments as mentioned in [0314] and the Examples of US '144. However, there is no disclosure or suggestion about pickling and chemical conversion treatment after temper rolling.

In Examples 3-6 of US '144, acid pickling is carried out after hot rolling, then cold rolling is performed. However, US '144 does not disclose or suggest that acid pickling is applied to the surface of the hot rolled steel sheet and then chemical conversion treatment is applied. In addition, US '144 does not disclose how to pickle the steel sheet (This assumes a conventional pickling method).

A conventional pickling method is described in Attached "Handbook of Iron & Steel" (Published Japan Iron & Steel Association, May 15, 1980). On page 508, a loss by pickling in the case of hydrochloric acid pickling is small in the area at the HCl concentration of 12-18%, temperature of 20-47°C and solubility rate of FeO is a large enough

compared with sulfuric acid. In Table 8.12 on page 508, various data are shown. It is understood that the above mentioned condition is a normal or conventional pickling condition.

According to the present invention, the pickling condition is that: HCl concentration of 7 - 15%, Fe ion concentration of 4 - 12%, temperature of 80 - 90°C for more than 40 seconds, HCl concentration x immersion time or less than 520. Although the HCl concentration overlaps partly, the ranges of Fe ion concentration and temperature are different in the present invention.

Further, on page 509, Fig. 8.41 shows a relationship between the ferric chloride content (wt%) and temperature in HCl bath and solubility of ferric chloride. Areas I, II and III have been added to Fig. 8.41 in the Attachment hereto.

In Fig. 8.41, the area I is a conventional pickling condition, and the area II is the content of ferric chloride converted from the temperature and HCl concentration according to the present invention, and the area III is an area between the temperature and HCl concentration of the present inventive condition. The areas II and III deviate because ferric chloride is saturated in solubility in the case of present inventive HCl concentration in area III. The ferric chloride content is about 25 - 35% in area III. However, when this content is converted considering Fe ion concentration of 4 - 12%, the appropriate content of ferric chloride becomes 9 - 27% as shown in area II.

Therefore, according to the present invention, pickling is carried out at the conditions in the area of low HCl concentration and high temperature without saturation of ferric chloride. On the other hand, conventional pickling is carried out at the conditions in the area of low temperature and high HCl concentration. Therefore, the present inventive

pickling condition is quite different from the conventional one. (The areas I, II and III in Fig. 8.41 are added).

The surface condition of the chemical converted treated steel sheet obtained by the present inventive pickling and the surface condition obtained by the conventional pickling will be explained.

The attached Figure A shows the surface condition of the chemical converted treated steel sheet obtained by the present inventive pickling. The attached Figure B shows the surface condition obtained by conventional pickling.

In Figure A, it is easily understood that fine chemical treated grains are observed and there are no bald spots. In Figure B, it is clearly seen that coarse chemical treated grains are observed and there are many bald spots. This is because the present inventive Fe ion concentration is 7% compared with the conventional one of 16% (HCl concentration and treating temperature are almost the same).

The ferric chloride converted from the Fe ion concentration is about 15% in Figure A (present invention). In case of Figure A (conventional), this value is 36%. Therefore, according to the present invention, pickling is carried out at the conditions in the area of low HCl concentration and high temperature without saturation of ferric chloride. On the other hand, conventional pickling is carried out at the conditions in the area of low temperature and high HCl concentration.

A method of conversion Fe ion concentration to ferric chloride uses the following formula.

FeCl_2 molecular weight = Fe atomic weight 56 + Cl atomic weight 35 x 2 = 126. Molecular weight of ferric chloride: 126/Fe atomic weight: 56 = 2.25. This means that

the ferric chloride content is 2.25 times the Fe ion concentration. Therefore, according to the present invention, Fe ion concentration of 4 - 12% is converted to FeCl_2 of 9 - 27%.

It is submitted that US '144 does not disclose or suggest the pickling of the present invention which is required to obtain the hot rolled steel sheet excellent in chemical convertibility free from bald spots and which has the surface roughness and pittings as defined in amended independent claims 1 and 2, all in accordance with the present invention.


It is therefore submitted that amended independent claims 1 and 2, and all claims dependent thereon, are patentable over US 2003/0111144).

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed to issue.

Respectfully submitted,

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